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Assessing Morocco's Transition to a Green Economy: An Indicator-Based Analysis (2010–2020)

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Abstract

While Morocco has embarked on an ambitious transition to a green economy, assessing its actual progress remains a challenge. Drawing on previous work on green economy indicators and progress assessment frameworks, this study aims to assess and project the dynamics of the green economy in Morocco over the period 2010–2020. The methodology selects and operationalizes 13 quantitative indicators aligned with national strategic priorities (including the share of renewable energy, GHG emissions, and protected areas) sourced from official national and international databases. These indicators are normalized using a min-max approach and aggregated with equal weighting into an annual composite Green Economy Index (GEI). The results reveal a clear improvement in the GEI, rising from 0.263 ("Low") in 2010 to 0.754 ("Above Average") in 2020, demonstrating the positive impact of investments in renewable energy and water management. However, this trajectory is uneven and vulnerable to exogenous shocks, as evidenced by the contraction in 2015 linked to a severe drought, and masks persistent structural challenges in the transport and industrial sectors. The study concludes that Morocco has laid solid foundations but that achieving a "High" performance level will require more profound structural reforms. Limitations include data availability constraints and the equal weighting of indicators. The

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main contribution lies in providing a reproducible monitoring tool and a basis for future comparative analyses.

Keywords: Green economy, Indicators for the green economy, Sustainable Development, Greening, Economy of Morocco

Introduction

Humanity is at a decisive turning point in its history, facing unprecedented environmental, social, and economic challenges that require a fundamental reassessment of our development models. Central to addressing these challenges is the need to reconsider prevailing economic paradigms, particularly the pursuit of growth without regard for environmental and social costs, which has led to the overexploitation of natural resources, excessive consumption, and the unequal distribution of economic benefits (OECD, 2008; Stiglitz, 2019). Furthermore, the socio-economic consequences of this model are alarming, with growing inequality, high unemployment, and recurring financial instability (OECD, 2015).

Economic growth, often seen as an indicator of progress, has been achieved at the cost of soil, water, and ecosystem degradation, as well as the destabilization of major natural balances, particularly the climate (IPCC, 2022). Furthermore, studies have shown that increasing income inequality slows economic growth, highlighting the importance of a more equitable distribution of resources (OECD, 2015).

Faced with these challenges, the concept of a green economy has emerged as an integrated response, aiming to reconcile economic growth, environmental preservation, and social equity (UNEP, 2011 ; Barbier, 2016). It is a multidimensional framework, covering economic, social, and environmental aspects. The adoption of a green economy has become a central objective of sustainable development policies since the Rio+20 Conference in 2012, which emphasized that each country must define its own path according to its national priorities (UN, 2012). Morocco further reinforced its international climate commitment by hosting COP22 in Marrakech in 2016, positioning itself as a leading voice for climate action among developing nations.

However, measuring progress towards a green economy remains a major challenge. There is no standardized methodology or universal index for assessing the green transition (Vukovic et al., 2019). Approaches vary among authors and institutions, combining environmental, economic, and social indicators in composite or hierarchical frameworks. Some studies favor sectoral performance indicators (renewable energy, sustainable agriculture, water and waste management) (Bukart, 2009), while others propose weighted global indices to assess the degree of greening of the economy (PAGE, 2022

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; Nahman et al., 2016 ; Chala & Orlovska, 2021). This debate highlights the complexity of the green transition and the need to adapt methodologies to national specificities and available data.

In Morocco, initiatives such as the Green Morocco Plan, the development of renewable energies, and the sustainable management of water and waste resources illustrate the country's commitment to this transition. Morocco's green transition cannot be understood in isolation from its broader economic development model, which has increasingly positioned sustainability as a core pillar of national competitiveness and long-term growth strategy.

Nevertheless, few studies have systematically assessed all this progress at the national level, limiting understanding of the advances made and the areas requiring priority action (The High Commission for Planning of the Kingdom of Morocco, 2020; PAGE, 2022).

This study aims to fill this gap by proposing an assessment framework adapted to the Moroccan context. Drawing on the methodology of Vukovic et al. (2019), we select criteria reflecting the key sectors of the green transition—renewable energy, water management, sustainable agriculture, and waste management—and analyze the evolution of these indicators between 2010 and 2020. The objective is to measure progress, identify areas for improvement, and provide recommendations to guide public policy and support sustainable development in Morocco.

Literature Review

The transition to a green economy requires a multidimensional assessment that goes beyond traditional economic indicators. To this end, researchers have developed various composite indices that incorporate economic, social, and environmental dimensions. These indices make it possible to track progress toward sustainability, compare countries, and measure change over time (Nahman et al., 2016).

The use of aggregated and normalized criteria, combining economic measures, greenhouse gas emissions, and social and environmental indicators, is common practice for obtaining a more comprehensive view of green economy performance (Chala & Orlovska, 2021; Vukovic et al., 2019; Nițǎ et al., 2024).

More recently, Sarkodie et al. (2023) constructed comprehensive green growth indicators across 203 countries, anchoring their framework on five dimensions including natural resource base, environmental productivity, and socio-economic outcomes, further illustrating the diversity of approaches and the persistent absence of a universal measurement standard.

Recent work also highlights the need for flexible methods adapted to national contexts, allowing local priorities such as energy policies, water

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management, and biodiversity conservation to be considered (Georgeson et al., 2017). These approaches show that measuring the green economy cannot be limited to a simple aggregation of indicators, but must incorporate a systemic and dynamic perspective.

Despite the rise of composite indexes, there is a lack of consensus on exactly how to measure progress toward a green economy. The main criticisms concern the selection of indicators, their normalization, weighting, and aggregation of results (Nițǎ et al., 2024; Georgeson et al., 2017). Normalization is essential to make indicators comparable, but different methods can produce divergent results depending on the references used (Vukovic et al., 2019).

Similarly, the weighting of criteria poses methodological challenges: equal weighting may not reflect the relative importance of certain sectors for sustainable development, while differentiated weighting requires justifiable and transparent choices (Vukovic et al., 2019). Finally, the aggregation of normalized values, often done using arithmetic means, can mask significant variations between sectors, and some studies recommend more sophisticated methods to better reflect the interdependencies between indicators (Chala & Orlovska, 2021; Nițǎ et al., 2024).

These methodological debates highlight the absence of a universal and accepted index for measuring the green economy, underscoring the need to develop tools adapted to the national context. Similarly, recent work applying multidimensional composite indices to assess green economy readiness across major emitting economies highlights the persistent methodological diversity in the field, with indicator selection and weighting remaining central points of contention (Falfushynska, 2025).

In the case of Morocco, where initiatives such as the Green Morocco Plan and investments in renewable energy are underway, the application of these methods makes it possible to better assess the country's actual performance and identify priorities for its transition to a sustainable economy (Vukovic et al., 2019).

This review thus establishes the theoretical and methodological framework for the analysis of national initiatives in Morocco, which will be presented in the following section, Context and Green Economy Initiatives in Morocco.

Context and Green Economy Initiatives in Morocco

The Kingdom of Morocco faces several environmental challenges. In addition to the pressures on biodiversity resulting from socio-economic factors such as deforestation, urbanization and overexploitation of biological resources, the country is characterized by environmental vulnerability in several respects. These vulnerabilities include a situation of water stress with

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significant repercussions on key sectors of the Moroccan economy, notably agriculture (Arabi et al., 2024). Secondly, an accumulated backlog in solid and liquid waste management, creating public health problems and hampering the development of economic activities. And a high level of energy dependency, with detrimental effects on external balances and public finances (PAGE, 2023). The critical situation of Morocco's water resources, combined with these existing vulnerabilities, risks becoming a major obstacle to the country's economic development and its population's access to safe, high-quality water in the future.

To address these challenges, Morocco has undertaken a number of initiatives aimed at making the transition to a green economy and promoting sustainable development in the country. Here are some of the key initiatives:

- *Renewable energy:* Morocco is committed to the massive development of renewable energy. This vision is formalized in its National Energy Strategy, which set an ambitious target of generating 52% of its installed electricity capacity from renewable sources (wind, solar, and hydro) by 2030 (Ministry of Energy, Mines and Environment, 2020). This goal is being realized through world-class, large-scale projects like the Noor Ouarzazate solar complex (one of the world's largest concentrated solar power plants) and significant wind farms, developed through successful public-private partnerships and international investment (MASEN, 2022).
- *Energy efficiency*: The National Energy Efficiency Strategy, formally launched in 2009 and reinforced under the Energy Transition Law 82-21, sets ambitious national targets and is implemented by the Moroccan Agency for Energy Efficiency (AMEE) (AMEE, 2023). Key initiatives include stringent compulsory energy audit programs and performance standards for energy-intensive industries and the building sector, alongside large-scale promotion programs for the adoption of solar water heaters and high-efficiency lighting and appliances (AMEE, 2023).
- *Sustainable agriculture:* The agricultural sector plays a strategic role in Morocco's development choices, given its economic importance (2nd largest contributor to VA, 13% of GDP), social importance (1/3 of the working population, 40% of working women), and territorial importance (2/3 of employment in rural areas). Some of the initiatives and actions undertaken as part of the "Plan Maroc Vert" aim to promote sustainable agricultural practices and ensure the sustainable management of natural resources (Ministry of Agriculture, Maritime Fishing, Rural Development and Water and Forests, 2023 ; FSD Africa, 2023).

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- *Waste management:* Action has focused on environmental upgrading, with several large-scale programs such as the National Household Waste Management Program launched in 2008. The cornerstone of this strategy is the transition away from uncontrolled dumping through the construction of engineered sanitary landfills and mechanical-biological treatment plants across the country to improve collection rates and disposal practices. Concurrently, the program promotes the integration of circular economy principles, supporting initiatives for recycling, composting, and waste valorization to reduce the volume of waste requiring final disposal and to create economic opportunities (Secretariat of State for Sustainable Development, 2020).
- *Water management:* The country is working on sustainable water management projects, including supply augmentation through the construction of large-scale infrastructure, including a network of over 140 dams for surface water storage and inter-basin transfers to balance regional disparities (Special Comission on the Development Model, 2021). Critically, the plan also emphasizes demand management, promoting highly efficient drip irrigation systems in agriculture—the largest water consumer—and pursuing wastewater reuse for irrigation to preserve freshwater resources (Ministry of Equipment and Water, 2021). Furthermore, the government is augmenting conventional resources with desalination projects, positioning seawater desalination as a strategic alternative to ensure drinking water supply for coastal cities and to reduce pressure on overexploited groundwater aquifers (Special Comission on the Development Model, 2021).
- *Biodiversity and ecosystem protection:* The conservation of protected areas and forest areas, as well as the monitoring of critically endangered species, is an integral part of national strategies to maintain ecological integrity. Driven by a strong national policy framework including its National Biodiversity Strategy and Action Plan and laws governing protected areas (Secretariat of the Convention on Biological Diversity, 2020), these efforts include the systematic expansion of its protected areas network to safeguard diverse ecosystems, targeted species recovery programs for critically endangered fauna like the Northern Bald Ibis, and large-scale reforestation and desertification combat programs integrated with climate change adaptation strategies (HCEFLCD, 2016; BirdLife International, 2022).

In summary, Morocco has implemented a combination of sectoral policies, investments, and infrastructure aimed at supporting its transition to a green economy. These initiatives are directly in line with the methodological criteria used to assess the country's performance, thus providing a concrete

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framework for applying and testing the methodology developed based on the work of Vukovic et al. (2019).

Methods

The green economy is a multidisciplinary field encompassing environmental and socio-economic aspects, the harmony of which contributes to the establishment of a sustainable economy. Karl Burkart proposes a definition of the green economy based on six main sectors, namely renewable energies, green buildings, sustainable transport, water management, waste management and land management (Bukart, 2009).

To assess Morocco's transition to a green economy, this study operationalizes this framework by selecting specific quantitative criteria. These criteria were chosen based on two main factors:

- Their alignment with Burkart's six sectors;
- Their relevance to the strategic initiatives and priorities defined in Morocco's national development plans, such as the National Energy Strategy, the "Green Generation" Strategy, and the National Waste Program.

A list of 13 criteria was selected to reflect the key areas in which Morocco is actively engaged. The initial list was refined to prioritize indicators with the highest probability of data availability for the period 2010-2020. The final list of criteria, their relevance, and data sources are presented in Table 1.

Table 1: List of criteria for a green economy assessment of Morocco

Number	Criteria	Relevance
1	Renewable share (modern renewables) in final energy consumption (%)	Enables the effectiveness of energy policies in promoting sustainable sources to be assessed.
2	Share of energy GHG emissions (%)	Provides crucial information on the carbon footprint of the energy sector, guiding efforts to reduce emissions and transition to cleaner sources.
3	Share of waste recycling (%)	Reflects the effectiveness of waste management policies, underlining the commitment to a circular economy and waste reduction.
4	Share of waste GHG emissions (%)	Assessing the environmental impact of waste treatment is crucial to sustainable management, minimising the greenhouse gas emissions associated with waste decomposition.
5	Share of transport GHG emissions (%)	Enables the sector's carbon footprint to be assessed, offering insights into how to promote sustainable means of transport.
6	Total GHG Emissions (Tonnes of CO2 Equivalent)	Make it possible to quantify the overall impact on the climate, guiding actions to reduce it.
7	Share of protected areas (%)	Conserving protected areas is essential for preserving biodiversity and maintaining healthy ecosystems.

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8	Share of forest land (%)	Crucial for measuring conservation efforts, carbon sequestration and the protection of forest ecosystems.
9	Localised irrigated area (k ha)	Offers insights into the efficiency of water use in agriculture.
10	Wastewater treatment capacity (in 1,000 cubic meters per day)	Crucial for assessing the management of water resources and the impact on the environment.
11	Number of waste water treatment plants	Reflects the infrastructure in place to treat wastewater, an essential aspect of preserving water quality and public health.
12	Number of waste sorting facilities	Indicates the level of infrastructure to encourage recycling, contributing to more sustainable waste management.
13	Agriculture Investments generated under the Green Morocco Plan (in billion DH)	Essential for understanding the commitment to sustainable agriculture practices and food security.

Source: Compiled by author.

The index includes both total GHG emissions and sectoral shares for energy, transportation, and waste. Although these indicators are related, they capture distinct dimensions of environmental performance: the total reflects the overall absolute pressure on the climate, while the sectoral shares reveal the relative evolution of the carbon intensity of each key sector. This approach allows for a more nuanced diagnosis, identifying whether a change in total emissions is attributable, for example, to the decarbonization of the energy mix or to growth in transport emissions. The min-max normalization method, by bringing all values to a common scale, mitigates any potential bias of excessive weighting of the climate dimension in the composite index. The analysis will therefore interpret the overall index by comparing it with the trends of these individual criteria for a deeper understanding**.**

To enable a comparative analysis of criteria measured in different units, the data for each criterion was normalized on a scale of 0 to 1. For each criterion, the best-performing year during the 2010-2020 period was identified. Depending on whether a higher value is desirable (e.g., share of renewables) or undesirable (e.g., GHG emissions), the following formulas were applied:

$$K_n = \frac{K - K_{min}}{K_{max} - K_{min}} \qquad \text{or} \qquad K_n = \frac{K_{max} - K}{K_{max} - K_{min}}$$

Where

K_n- the normalized value of the criteria;

K- the current value of the criteria;

K_{max} or K_{min}- the best maximum or minimum value of the criteria

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By selecting a reference year for each criterion where performance reaches its peak, we can assess the current situation and identify changes over time, making it possible to track the evolution of the green economy using this approach. Normalizing data is crucial to making criteria comparable. The formulas measure relative performance against a benchmark, ensuring that all criteria are assessed in the same way. This facilitates the comparison and aggregation of criteria for an overall assessment of the green economy.

By setting the benchmark at 1, we place a high value on performance, seeking to get as close as possible to this value. Consequently, a normalized value close to 1 indicates optimal performance, while a value close to 0 indicates sub-optimal performance. This approach encourages action to improve performance in all areas. Furthermore, selecting a base year allows the assessment to be adapted to Morocco's specific sustainable development objectives. For example, for greenhouse gas emissions, the baseline year could be the year when emissions were at their lowest, reflecting the emissions reduction target.

To obtain an overall assessment of the greening of the Moroccan economy for each year, a composite Green Economy Index (GEI) was calculated. The GEI is the arithmetic mean of the normalized values of all criteria for that year. with equal weighting applied to all 13 indicators, reflecting the absence of empirical consensus on the relative importance of each sector in the Moroccan green transition context and ensuring methodological transparency and reproducibility. This gives an overview of the evolution of the average performance of the green economy.

The annual composite score of the GEI was interpreted using the adapted rating scale of Vukovic et al. (2019) to assess the level of greening of the Moroccan economy each year.

Table 2: Indicators of greening the economy

Indicator value range	Greening level
[0.0;0.2)	Extremely low
[0.2;0.4)	Low
[0.4;0.6)	Medium
[0.6;0.8)	Above average
[0.8;1.0)	High

Source: Vukovic et al. (2019)

Results & Discussion

The full results of the assessment of Morocco's green economy over the period 2010 to 2020 are presented in Table 3 below. This table groups together the normalized values for each year, allowing a comparison of Morocco's performance in its transition to a green economy.

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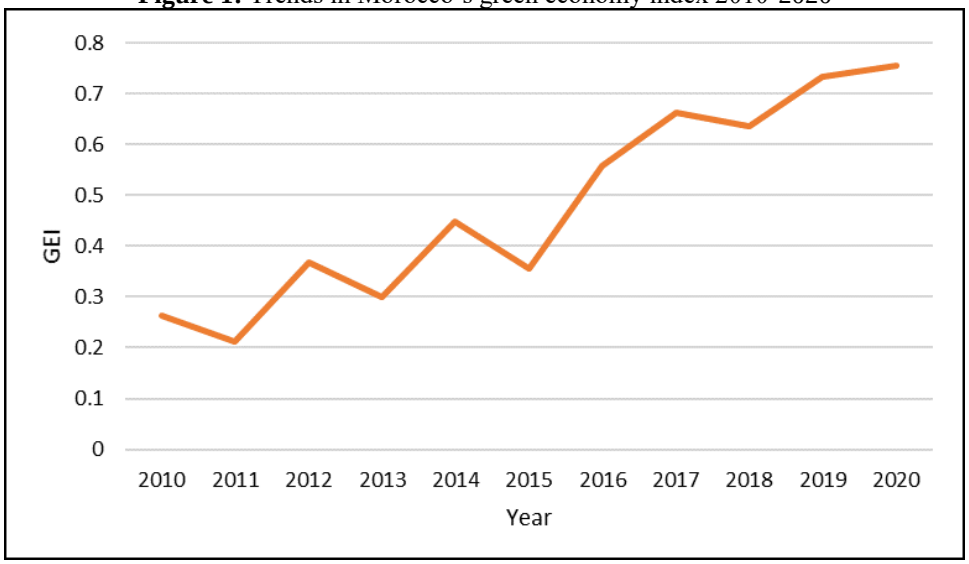
Table 3: Evolution of Morocco's Green Economy Index (GEI) (2010-2020)

Year	GEI	Greening Level	Change Index
2010	0.263	Low	-
2011	0.212	Low	-0.051
2012	0,368	Low	-0.156
2013	0.299	Low	-0.069
2014	0.449	Medium	0.150
2015	0.356	Low	-0.143
2016	0.557	Medium	0.201
2017	0.662	Above average	0.105
2018	0.636	Above average	-0.026
2019	0.734	Above average	0.098
2020	0.754	Above average	0.020

Source: Compiled by the author

The main trend is illustrated in Figure 1, which shows the change in the value of the GEI over the study period.

Figure 1: Trends in Morocco's green economy index 2010-2020



Source: Compiled by the authors

Analysis of the results reveals a clear and positive improvement in Morocco's overall environmental performance over the decade 2010-2020. The GEI value increased by 187%, from 0.263 to 0.754. This significant improvement has enabled the country to make a qualitative transition from a "Low" level of greening to an "Above average" level.

The evolution of the index is not linear and allows us to identify three distinct phases in Morocco's transition:

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1. Latency and Fluctuation Phase (2010-2013):

During this initial period, the GEI remained in the "Low" range (< 0.4) and showed annual variations without any clear trend. This fluctuation probably reflects the design and launch phase of major national programs, where investments are committed but have not yet generated measurable impacts at the macroeconomic level. The variations could be attributed to external factors, such as climate variability impacting the agricultural and water sectors.

2. Take-off phase (2014-2016):

This period represents a crucial turning point. The significant jumps observed in 2014 (+0.15) and especially in 2016 (+0.201) bring the GEI into the "Medium" category. This acceleration coincides directly with the operational launch of structural projects included in national strategies. The start-up of the Noor Ouarzazate solar power plant (2016), the development of wind farms, and the maturation of the Green Morocco Plan programs have begun to produce tangible results, which are reflected in a robust improvement in normalized indicators.

3. Consolidation and Stabilization Phase (2017-2020):

From 2017 onwards, Morocco's environmental performance stabilized sustainably in the "Above Average" range. Progress continued, albeit at a more moderate pace, marking the institutionalization of green economy practices. The slight contraction in 2018 (-0.026) could be explained by an investment cycle or drought, but the immediate recovery in 2019 demonstrates the resilience of the positive trajectory. This phase indicates that the green transition is no longer driven by pilot projects but is now embedded in the country's economic development model.

To contextualize this performance, Morocco's 2020 GEI score of 0.754 compares favorably with similar assessments of emerging economies, though direct comparison remains limited by the absence of harmonized international benchmarking frameworks such as the GGEI or OECD Green Growth indicators. It should further be noted that the 2020 score may be partially influenced by the temporary reduction in economic activity and emissions resulting from the COVID-19 pandemic and associated lockdown measures, rather than reflecting purely structural advances in the green transition. This methodological caveat should be considered when interpreting the endpoint of the index trajectory.

The overall positive trend masks necessarily mixed sectoral performances. A preliminary analysis of individual criteria (not detailed here) suggests that the rise in the index is strongly driven by strategic sectors that have benefited from massive investment and a dedicated policy framework:

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- The renewable energy sector has undoubtedly been the main driver, with a growing share in the electricity mix.
- Efforts in waste management (increase in sorting facilities) and wastewater treatment also contributed to the rise.
- Land and forest conservation policies have shown steady progress.

However, the analysis also reveals persistent areas of tension. The decline in 2015, in particular, could be linked to the performance of indicators sensitive to climatic conditions (agriculture, water stress) or to The persistent growth of emissions in hard-to-abate sectors, particularly transportation, whose share of total GHG emissions has continued to rise, slowing the index's progress in certain years.

Analysis of official data and reports confirms that the contraction of the index in 2015 (-0.143) is mainly attributable to a severe drought and its impact on the energy mix, coupled with structural growth in emissions from certain sectors. Morocco experienced a year of low rainfall in 2015, prolonging a period of water stress. According to World Bank data, average annual rainfall in Morocco in 2015 was significantly lower than the average for previous decades (World Bank, 2023).

Impact on Energy Production: This drought directly impacted dam fill levels. The National Office of Electricity and Drinking Water's 2015 Annual Report (ONEE) confirms this decline, indicating that hydroelectric production fell to represent only 5.8% of national electricity production that year, compared to a higher average in normal years (ONEE, 2016). To compensate for this shortfall, production from thermal power plants (coal and gas), which emit much more GHG, was increased. The same source (ONEE, 2016) shows that thermal production accounted for most of electricity generation.

While the country was battling drought, demand for transportation continued to grow. According to the 2017 National Sustainable Development Strategy Monitoring Report, transportation sector emissions rose steadily during this period, making it one of the most challenging sectors to decarbonize (Ministère de l'Environnement, 2017). This episode highlights the vulnerability of the green transition to climate hazards and underscores the urgent need to continue diversifying the energy mix and decarbonizing the most polluting sectors, such as transportation.

In conclusion, the Green Economy Index results show the significant progress Morocco has made since the start of the 2010s and highlight the positive impact of public policies targeting strategic sectors such as renewable energy. However, the GEI's trajectory also reveals the structural limitations of this approach. Growth in the index has been uneven and vulnerable to exogenous shocks, as illustrated by the contraction in 2015, and has been heavily dependent on massive investments in a few selected areas.

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Conclusions

Measuring progress in the transition to a green economy remains a complex and highly political undertaking. Unlike standard economic indicators such as GDP, there is no single methodology or international consensus on how to precisely define and quantify a nation's "green performance." This lack of a universal framework, often perceived as a weakness, can in fact be a strength: it implicitly recognizes that sustainability trajectories are necessarily pluralistic, having to adapt to each country's specific geographical features, industrial heritage, natural resource endowments, and socio-economic development priorities. Morocco's green transition cannot be understood in isolation from its broader economic development model, which has increasingly positioned sustainability as a core pillar of national competitiveness and long-term growth strategy. It is in this spirit that this study has proposed a contextualized assessment grid, anchored in the strategic sectors identified by Morocco itself, in order to paint a more accurate picture of its unique trajectory.

This research has enabled the creation and calculation of a Green Economy Index (GEI) to quantitatively assess this trajectory over the period 2010-2020. The results show clear and significant progress: the country's GEI has more than doubled, rising from a level classified as "Low" (0.263) to "Above Average" (0.754). This substantial improvement validates the positive impact of strategic investments and ambitious public policies launched during this decade, particularly in the key areas of renewable energy, water management, and agricultural modernization. Morocco has thus succeeded in creating positive momentum and laying a solid foundation for its sustainable development model.

However, analysis reveals that this transition remains incomplete and vulnerable. The GEI's trajectory has been marked by fluctuations, including a notable decline in 2015, illustrating the sensitivity of national environmental performance to exogenous shocks such as drought. Above all, the index's growth has been uneven across sectors, driven mainly by large-scale energy projects, while key sectors such as transportation, waste management, and industry have continued to see structural growth in emissions. The stabilization of the index at the end of the period suggests that the "quick dividends" of initial investments have been captured. From now on, achieving a "High" performance level will require moving beyond a project-based approach to engage in more complex and politically demanding structural reforms, such as strict regulation of industrial emissions, environmental taxation, aggressive promotion of the circular economy, and a profound transformation of the mobility system.

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Policy Recommendations

Based on these findings, the following policy priorities are recommended: (1) accelerating the decarbonization of the transport sector through investment in public transit and electric mobility; (2) strengthening environmental taxation frameworks to internalize the cost of industrial emissions; (3) expanding the circular economy through incentivized recycling infrastructure; and (4) establishing a national green economy monitoring system with standardized annual reporting to track progress beyond 2020.

However, the pace and depth of these reforms will ultimately depend on the strength of institutional frameworks, the availability of financing, and the political will to move beyond sector-specific interventions toward an economy-wide green transformation. In the regional context, Morocco's trajectory positions it as a potential model for other African and MENA nations, though meaningful comparative assessment would require harmonized measurement frameworks across countries. Global comparative analyses such as Sarkodie et al. (2024) demonstrate that green growth trajectories vary significantly across income groups and regions, underscoring the value of country-specific assessments such as the one proposed in this study.

Furthermore, this study focuses primarily on environmental and economic dimensions, leaving the social aspects of the green transition, including green job creation, income inequality, and equitable access to green infrastructure, as important avenues for future research.

The scope and implications of these findings must however be considered in light of the study's inherent limitations, including data availability constraints and the equal weighting of indicators, which are discussed in detail in the following section.

Study Limitations and Future Research Directions

It is important to recognize the inherent limitations of this research, which also open up avenues for future work:

- *Data Availability and Quality:* Data Availability and Quality Constraints: The selection of criteria was severely limited by the lack of reliable and consistent annual public data for several indicators that are essential to a holistic assessment of the green economy. Above all, the inability to include crucial metrics such as green investments as a percentage of the total budget, net creation of green jobs, the share of green vehicles in the vehicle fleet, the carbon footprint of imports, etc. is a substantial limitation. This constraint, which is characteristic of measurement challenges in many developing countries, necessarily reduced the scope and granularity of the analysis. The study thus captures environmental outputs (e.g., emissions, installed capacity) but

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struggles to measure the inputs and socio-economic transformations (e.g., financing, jobs, behavioral change) of the transition.

- *Index Weighting:* The chosen method, equal weighting of all criteria, is transparent but may be considered simplistic. It assumes that each sector has the same importance in the green economy, which may not fully reflect the reality of national priorities or environmental impact;
- *Scope of the Analysis:* The study focuses on aggregate performance at the national level. It does not account for potential regional disparities in the implementation of green policies or social inequalities related to this transition (environmental justice, access to the benefits of green growth). Furthermore, this study focuses primarily on environmental and economic dimensions, leaving the social aspects of the green transition, including green job creation, income inequality, and equitable access to green infrastructure, as important avenues for future research.

Future research could expand on this work by incorporating more granular data, testing alternative weighting methods, and exploring the spatial and social dimensions of Morocco's green transition in order to provide a more comprehensive and multidimensional picture. It could also enhance the analytical depth of this framework by incorporating sensitivity analyses to test the robustness of the equal weighting assumption, as well as cross-country comparisons with peer economies in the MENA region.

Despite these limitations, this study provides an assessment framework and offers valuable empirical evidence of Morocco's progress. It highlights that while the country is on the right track, the next, and most challenging, step in its transition will be to green its entire productive apparatus and embed sustainability at the heart of all sectors of activity in order to realize its ambition of leadership in the green economy on the African continent.

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